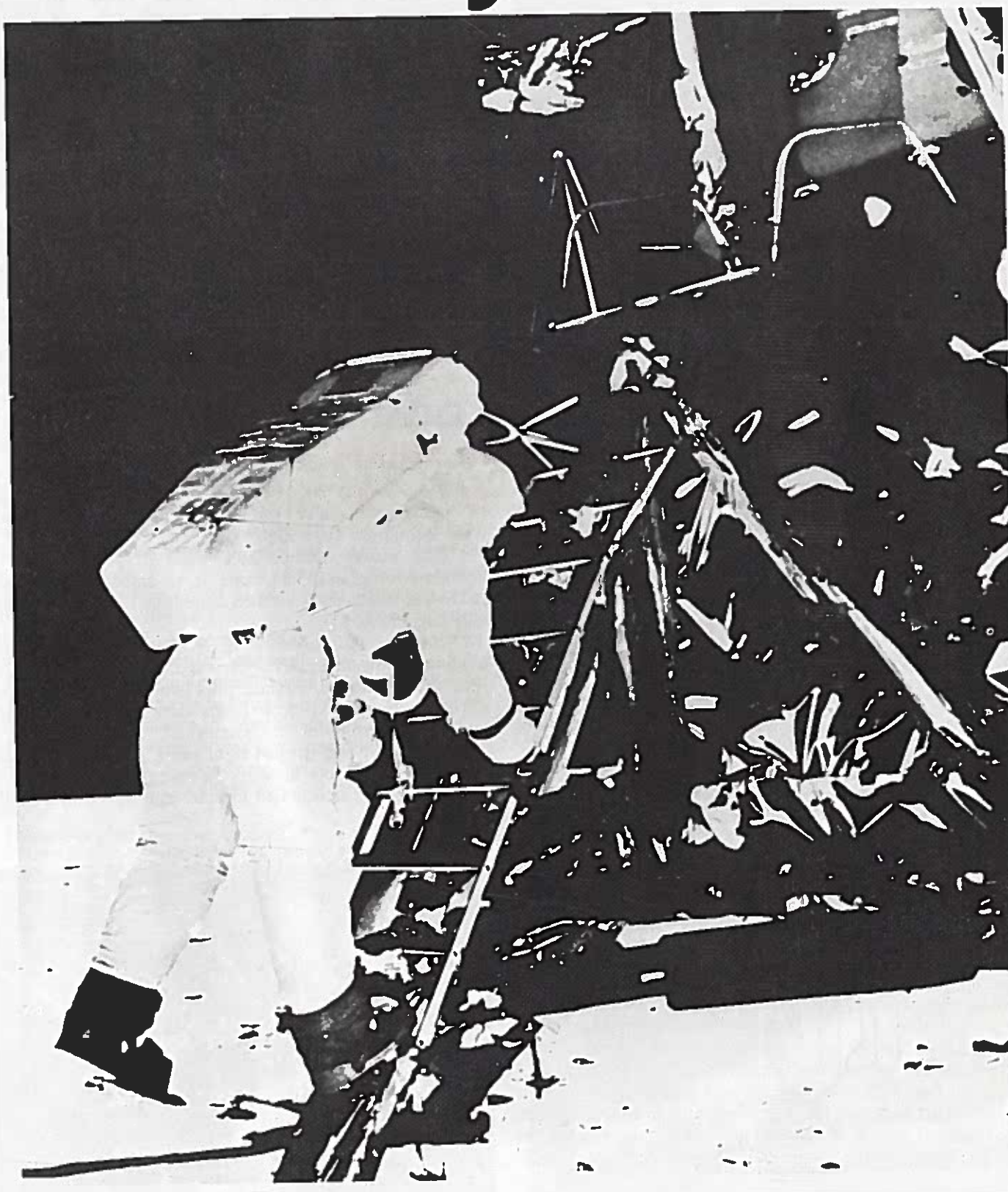
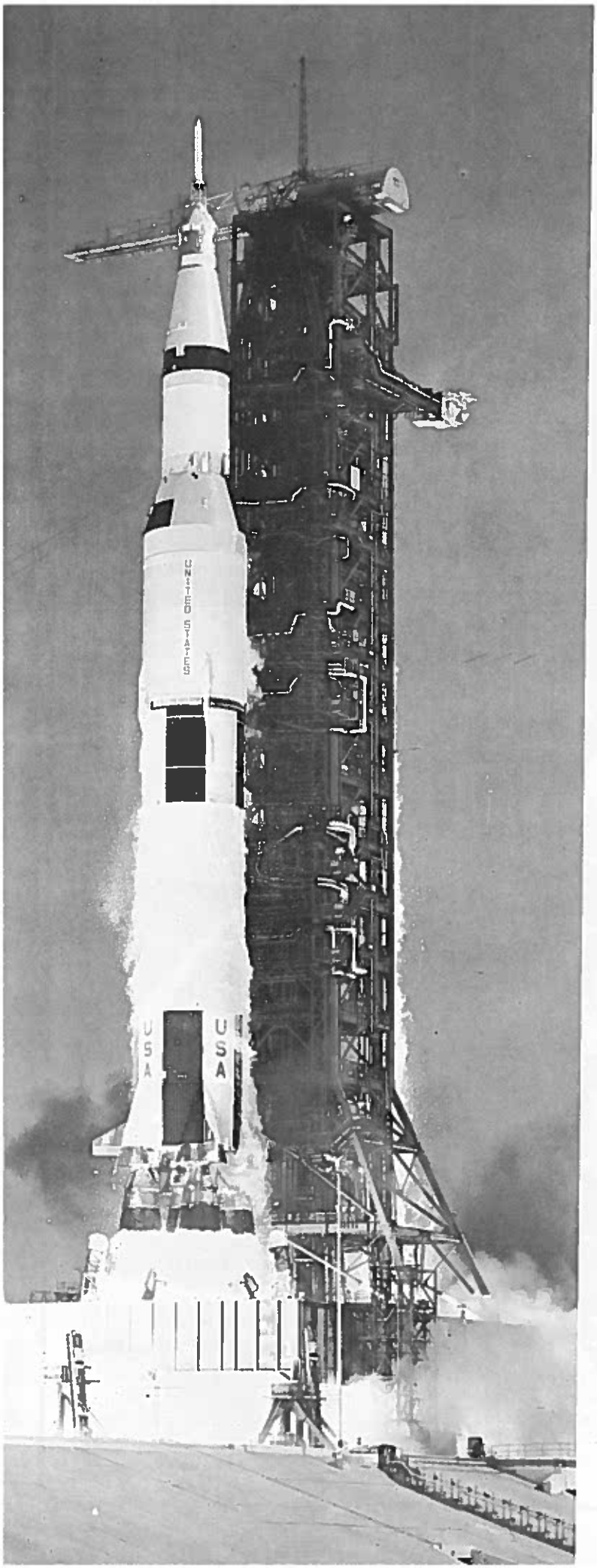
'Houston...Tranquility base here. The Eagle has landed'





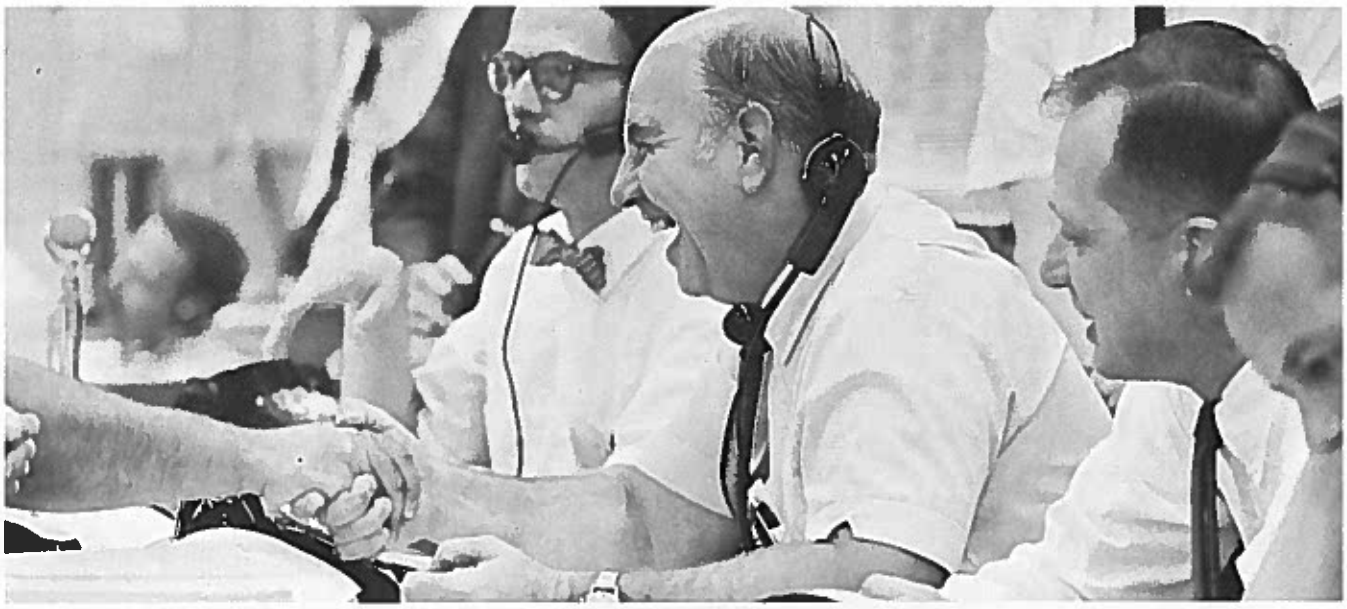
Apollo astronauts flew to the moon . . . and millions more rode with them

"We are in a new era. We've been there since 4:17:40 p.m Sunday, July 20, 1969. Hundreds of millions listened as Apollo commander Neil Armstrong announced: 'Houston. Tranquility Base here. The Eagle has landed.'

"The Lunar Module had made it. It had gone to another world, and had done it so smoothly and flawlessly the whole thing seemed incredible. The unbelievable had been done."

That was the way PLANE NEWS described the first landing on the moon five years ago. Astronaut Mike Collins, the Command Module pilot who orbited the moon during the lunar stay of Neil Armstrong and 'Buzz' Aldrin, had another word for it: "Fantastic!"

And that it was. In just eight years, the talents of more than 300,000 people at work in more than 20,000 companies had been closely tied together and united in a single,



peaceful national mission—one that fulfilled the dreams and aspirations of Man down through countless centuries. It was an astonishing technological achievement—one that gave proof to Man's ingenuity, perseverance, and perhaps more than anything else, his indominitable spirit.

For the hundreds of millions of people throughout the world who watched the dramatic event on television, they knew they were sitting in on history in the making—and from a vantage point a quarter-million miles away!

At that moment, the future of space exploration seemed assured.

Some of the more ambitious proposed follow-on missions to Apollo included a trip to the so-called "back side" of the moon—that seemed intriguing to some scientists since it would provide a radio telescopic view of the universe, unobstructed by radio interference, one not possible from the front side of the moon; a series of extended space station missions which could provide more data on man's ability to work and live in a deep space environment; even a manned mission to Mars seemed well within the possibility of American scientific competence.

But that was before Vietnam caused a deep division in the nation; before crop failures and droughts visited large areas of the world; before the continued growth of populations and material expectations stretched the world's resources to the breaking point and helped produce global inflation . . . and brought about a re-evaluation of national priorities.

Five years after that first successful voyage to the moon, what had looked like a sure possibility for a decade of continued space exploration has turned out to be somewhat different from the planning going on in 1969 and 1970.

Things looked almost as dark at the beginning of the '60s. As one engineer put it: "We started in 1958 to think about manned space programs, and as early as August 1960 we submitted our first, preliminary study on Project Apollo. That was when the theory of a Command-Service module going straight to the moon was current.

"Then NASA held a competition, and ITT and Grumman presented a follow-up study of Apollo—in October of 1960. We lost that one.

"By May of '61 we had compiled four volumes on results of in-house studies that we submitted to NASA to keep them aware that we were still in there pitching. In October there was a competition for hardware for Apollo. We were in that, with General Electric for the Command Module—we lost that one, too.

"But in early 1962, Joe Gavin, Tom Kelly and others started developing the Lunar Orbit Rendezvous concept—which we validated. Then NASA decided to hold a competition for LM. With RCA as prime subcontractor, we submitted our proposal in September. In November we were awarded the contract.

"It took a lot of foresight and a sizeable—for those days—investment. But most of all, it took perseverance."

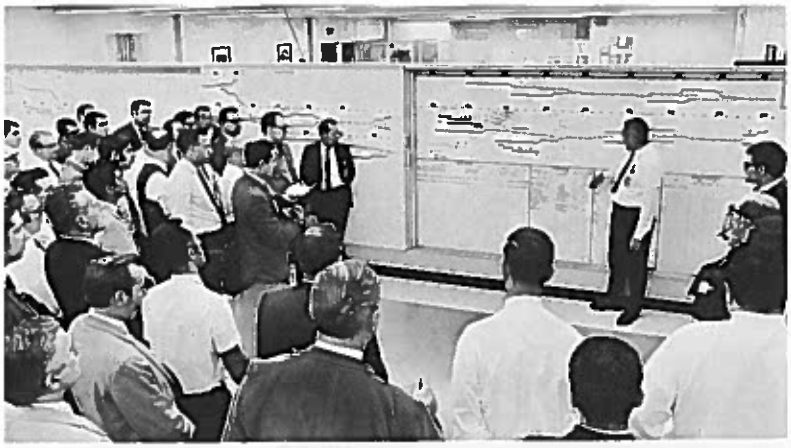
Negotiations on that contract should have indicated the kind of hectic existence that was to come for those associated with the program. About 80 from Grumman spent the period from mid-November to the day before Christmas in 1962 in Houston negotiating the original contract. During that month-and-a-half, negotiating sessions ran well into the night as NASA and Grumman hammered out terms of the agreement, but when it was finally concluded—the actual contract signing took place right after the start of 1963—Grumman was solidly in this nation's space business with a design and production contract for the Lunar Module that would approach $2 billion before the program was completed.

Winning the contract was one thing; fulfilling it was another.

Although life for many persons at Grumman had always been one urgent program leading into another urgent program, the Lunar Module was composed of some dramatic elements that were much different from anything that had gone before. Looking back at those days in a recent interview, Board Chairman Joe Gavin (Vice President - LM Program Director in 1963) stated:

"For one thing, we were operating in a highly visible national program. The Lunar Module was only one element of a much larger undertaking and we were continually conscious of the fact that we had to make the schedule to keep pace with every other Apollo contractor . . . and we knew if we didn't we would cause a slippage the entire nation would read about.

"Secondly, the task that we took on had so many unknowns. It was quite different from starting out on, say, a new airplane. We've flown airplanes before and the next airplane — no matter how complex and advanced — represents only an incremental improvement over the last one. When we embarked on LM it was to be the first 'true' spacecraft. Unlike the Command-Service module, LM was to operate only in an outer-space environment and we had



no past experience in that field to draw on."

And there were other considerations as well. Gavin recalled the time, in 1965, when "one distinguished scientist who was here for lunch suggested that the surface of the moon was covered with at least a 10-meter layer of dust and that the Lunar Module would settle out of sight when it landed on the moon. Or, if that didn't happen, the dust would migrate up over the LM and cover it because of the electrical properties involved. Fortunately, his hypothesis turned out not to be correct."

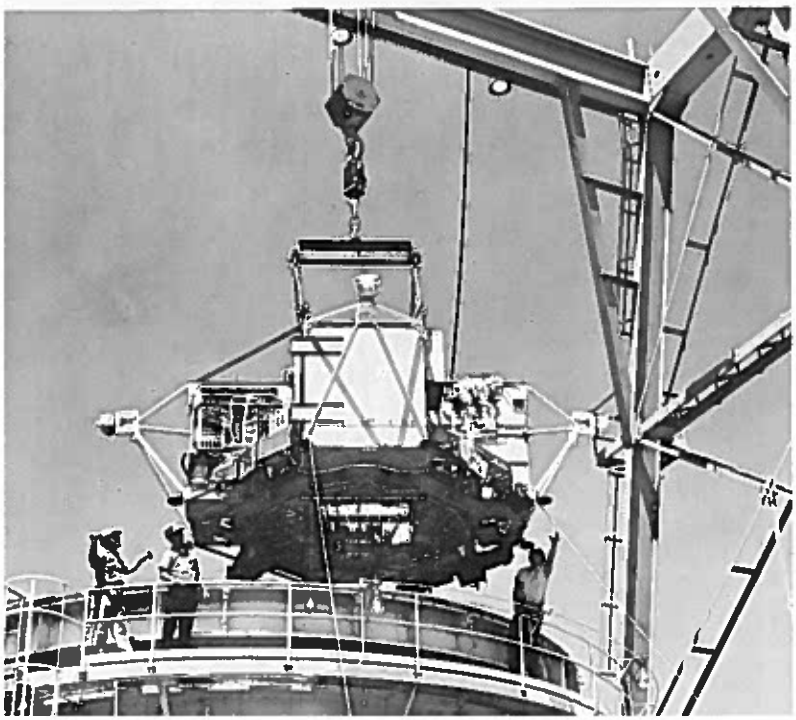
'Tremendous learning process'

But as Gavin points out, such theories couldn't be totally discounted without much evaluation and consternation . . . and because of those considerations, there was much more time spent on worrying about such possibilities than is normal on a new aircraft development program, for example.

"Engineers and scientists engaged in the Apollo project went through a tremendous learning process during those early years. When I look back and think how naive we were in '65 as compared to '68, it was incredible how much we learned in those years."

The pressures were mounting. In 1961, President John F. Kennedy committed this nation to landing a man on the moon and returning him safely to earth before the end of the decade.

As time progressed, the need for success became paramount. It became apparent to those who were working with NASA on the Apollo project that they were operating in full view—not just of their own countrymen, but of the entire world as well. Mission success became not a question of probability, it became an absolute necessity. As that realization dawned, it naturally imposed greater and greater pressures and exacted greater and greater demands on just about everybody working on the program.



The pressures were unyielding. Seven-day weeks became the rule, not the exception. Standards more stringent than ever before were established for the manufacture of parts and assemblies; cleanliness became more than an objective, it became a passion; quality control measures that would be considered unduly severe in most circumstances were accepted as the only way to assure vehicle reliability and mission success; new techniques were developed by engineering and manufacturing to help speed production of the vehicle and guarantee faultless operation during its space voyage.

Those were hectic days. As one manufacturing supervisor remembers it: "There was a tremendous feeling of camaradarie. We were all committed to delivering a quality product on schedule and launching it on time. When anything went wrong during production, no one thought about placing the blame—the big concern was fixing the problem. Mistakes were admitted—everybody knew that a mistake that went unadmitted or unnoticed might have meant a one-way ticket for those astronauts. That was foremost in everybody's mind."

The fear that any contamination — perhaps a thumbprint, a hair, even a tiny particle—might prejudice a flight resulted in the establishment by NASA and Grumman of a set of strict standards to guard against the possibility. Thousands of parts were scrupulously cleaned and, where necessary, bagged in plastic until assembled.

In the LM final assembly area in Plant 5, a unique rotate-and-clean—also known as the rollover—fixture was employed to spin the finished product through a three-axis trip. The "shakeout" assured LM quality control personnel that there were no foreign objects contained in the vehicle, although that possibility was highly unlikely. As each LM was final assembled, a quality control monitor checked each person and each piece of equipment that went into a vehicle. And when that person exited the LM cabin, the monitor would again make sure that each piece of equipment, each tool brought in was brought out—or otherwise accounted for. Extraordinary precautions? Not on LM. The stakes were too high.

Not all activity was centered on Long Island. In 1964, Grumman sent a team to the White Sands Test Facility in New Mexico, and in 1965, began testing of LM propulsion systems in high-altitude test stands.

That same year, 1965, a small contingent left Bethpage to prepare for site activation at Kennedy Space Center in Florida. President George Skurla (then KSC operations manager) described the Grumman experience in the giant spaceport in these terms:

"Site activation was a very critical time for us. Kennedy Space Center with its Vehicle Assembly Building and launching pads is just a massive complex of ground-support equipment. There are miles and miles of electrical cables and hoses and all types of instrumentation and other equipment that is critical to the test, checkout, and launching of space vehicles.

"For months and months we ran night *and* day installing, validating, and tieing these various equipments into the

entire NASA complex at KSC to make sure that when the first LM arrived from Bethpage, we'd be ready. I, for one, have never lived through a more demanding period in my whole life."

But it was only the beginning. What followed—the arrival in June 1967 of the first Lunar Module from Bethpage—put the Grumman team at KSC under even more pressure to demonstrate that it was ready not only in terms of site activation, but ready as well to perform the rigorous pre-launch checkout of the spacecraft.

'Agony and the ecstasy'

"The agony and the ecstasy is how I describe that period. It was the agony of long hours and living in a real-time world. It was keeping up with the master schedule, the integrated skills of all the other Apollo contractors at the Cape.

"It was a very demanding period—one that exacted its toll on all of us. Never before had so many given so much for so long.

"When the Director of Launch Operations asked if our vehicle was ready to go during the pre-countdown briefing," Skurla said, "before we could say 'Yes' we had to make absolutely sure that our bird could perform as we had promised, without compromising the safety of the crew or the success of the mission. At that time, you could say, 'The buck stops here.' "

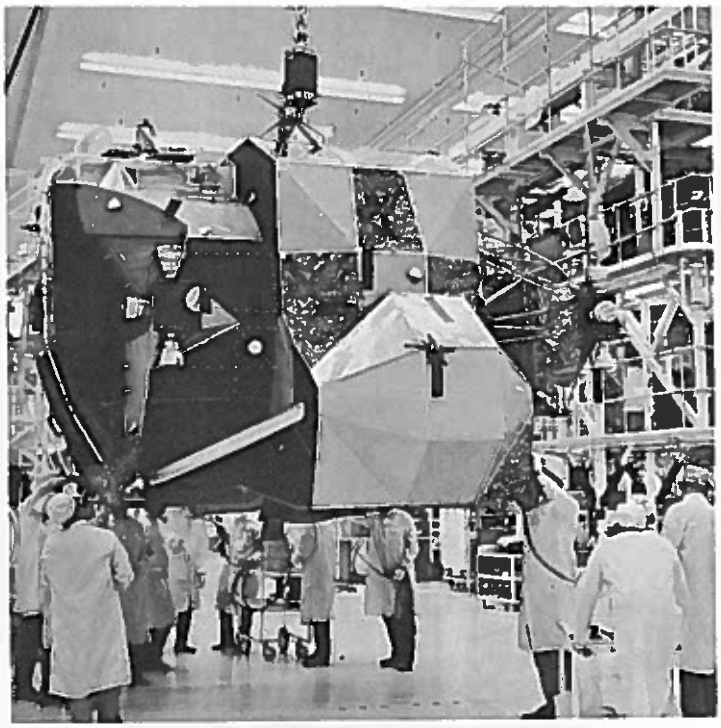
And it was the ecstasy, too. "When a bird flies as free and beautiful as ours have, the intense pressure, the long hours, the awesome responsibility all seem worth it. Those hectic weeks were forgotten, for awhile at least, and were replaced by the knowledge that we had participated in a truly historic undertaking. I'd have to say it was the zenith of my professional career—and I'm sure a number of others associated with the program would agree with me."

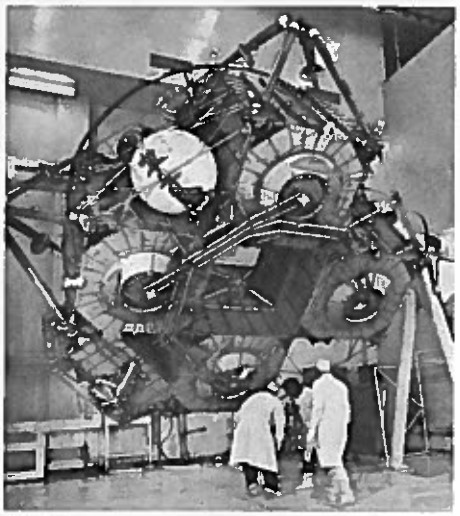
In the altitude chamber at the Manned Spacecraft Center (now Johnson Spacecraft Center) in Houston, another Grumman team prepared the Lunar Module for a series of manned tests at the NASA site that were a necessary preliminary to manned space flight.

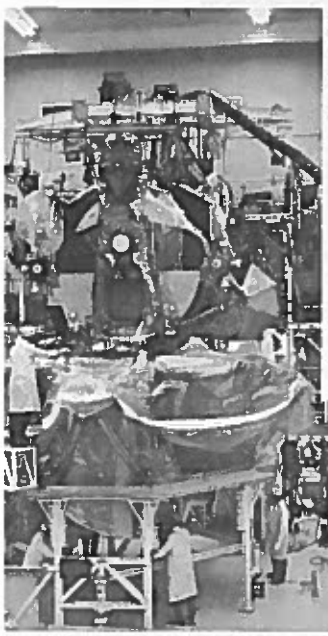
Because of the highly hazardous nature of the manned testing at Houston, propulsion testing at White Sands, and launch operations at KSC, an entirely new set of stringent safety standards had to be established to guard against any possibility of disaster. The same was true at Bethpage, especially at the High Pressure Test Facility at Plant 5.

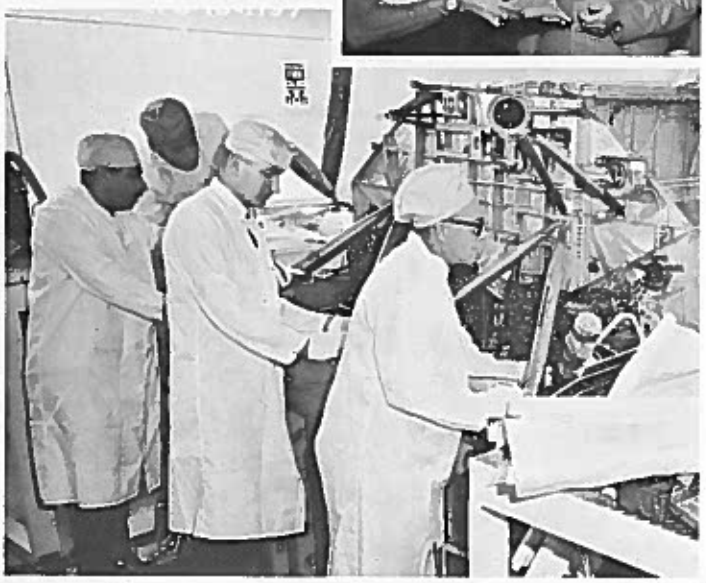
Precise moment-to-moment steps were blocked out during these various operations. Given procedures had to be performed in an exact way. Directions were minutely described. Every step was carefully monitored, checked, rechecked, and documented for future reference. Every change or deviation in a procedure was noted . . . sometimes to become an integral part of operational procedures. Hazards were specifically identified — and a safety man was on hand during hazardous tests to stop any such test dead in its tracks if he determined it were approaching a dangerous condition.

The nit-picking, the frustration, the super-caution were well worth it. Working with volatile fuels high on towering gantries or during tests in vacuum chambers or at a propulsion test stand is dangerous business . . . but Grumman completed the Apollo program with an outstanding safety record, one that was cited by NASA several times at Kennedy Space Center and one that earned salutes in other areas of LM operation as well.









As the launch date for the first moon voyage approached. the pressures seemed to increase. The world was watching . . . and waiting. Earlier LMs had operated successfully aboard Apollo flights and that, in a way, provided increasing assurance that the first lunar landing would be successful. But it was no time to let up. Behind LM-5, the first vehicle scheduled to land on the moon, were other Lunar Modules being prepared for future missions. That realization persuaded program managers to keep looking downstream, applying all the management skills and techniques learned over the past eight years that proved so vital in pulling together such a monumental undertaking.

There was never a dull moment. A few weeks before blast-off, engineers and technicians effected an emergency change on the lunar lander to compensate for the extra heat expected to be generated by reaction control engines as LM-5 approached the lunar surface. The fix resulted from a further analysis of landing gear insulation made only a couple of months earlier. No one was leaving any room for error.

As those final hours approached on July 20, 1969, Joe Gavin stated: "A great many people who have put out extraordinary effort in the last five to seven years will be hanging on every second of this mission."

Of course, it's history now. Armstrong's terse commentary when LM landed on the lunar surface was followed some hours later by: "That's one small step for a man; one giant leap for mankind." Man had finally set foot on a world other than his own.

There may have been some who were able to completely control their emotions that day. Not many, surely. Sitting in MSC Mission Control that day with the late Lew Evans, Tom Kelly, the prime designer for Grumman on the Lunar Module, George Skurla, and Jack Buxton, Joe Gavin admits to being pretty limp along with a number of others, especially during lift-off from the moon. It was a very tense and a very emotional experience, especially for those who were associated with the Lunar Module program.

'Tremendously proud'

One person put it this way: "You couldn't help being proud. Tremendously proud. When you consider all the things that might have gone wrong, even though we tested and re-tested, inspected and re-inspected. It was simply a smashing achievement."

It *was* a "smashing achievement"—a tremendous demonstration of what could be done when people unite in a single, well-defined, and determined effort to achieve a worthwhile goal.

Neil Armstrong and Buzz Aldrin brought these words to Grummanites during a homecoming celebration at Bethpage. Armstrong said: "We didn't come to make speeches, but just to congratulate you for your excellence and to thank you for giving us one grand spacecraft."

Aldrin put it in broader terms: "Apollo was more than three men going to the moon, more than the government and industry teams—it was America, it was the world."

Later missions to the moon were even more successful. The Grumman Lunar Module performed flawlessly during the seven moon missions, and on one, Apollo 13, proved its worth conclusively when it was employed as a "lifeboat" to shelter and nuture three Apollo astronauts following an explosion aboard the Command-Service module.

But a nation and a world beset with larger problems

soon lost interest in the space undertakings, spectacular as they were. Sights once set so high had to be re-scaled because of global conflict, famine, disease, inflation and even, surprisingly enough, ennui.

Severe cutbacks in U.S. space planning were followed by drastic reductions of personnel throughout the space industry.

After contributing immeasurably to U.S. space achievements, Grumman, too, found itself just about out of manned space endeavors planned for the future. But could Grumman accept a lesser role after marching stride for stride with other giants of the aerospace industry during the Apollo project? The answer seems evident—certainly not.

The key word has to be perseverance . . . as it was more than a decade ago. It was that type of spirit that imbued those space pioneers at Grumman in the early '60s and prompted them to hang in there even though they suffered initial defeats. It paid off then, it will again.

Substantial benefits

There are some solid technical and management spin-offs from Apollo, however, that are now being applied to various programs throughout the company. Among them are:

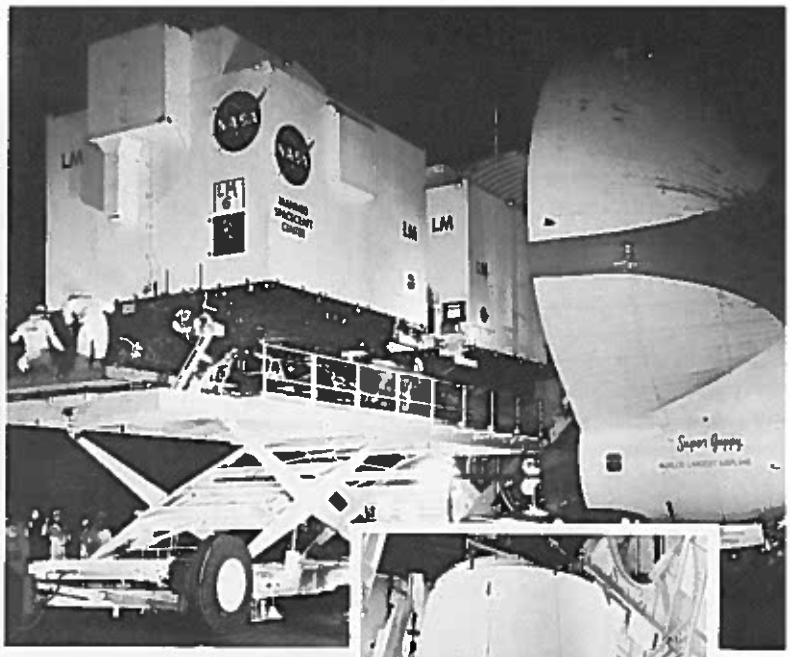
- A better appreciation of vehicle realiability and the various trade-offs involved
- Much improved computer programming technology
- A competent and reliable fly-by-wire technique established for Apollo
- Development of innovative management techniques and establishment of higher operational standards

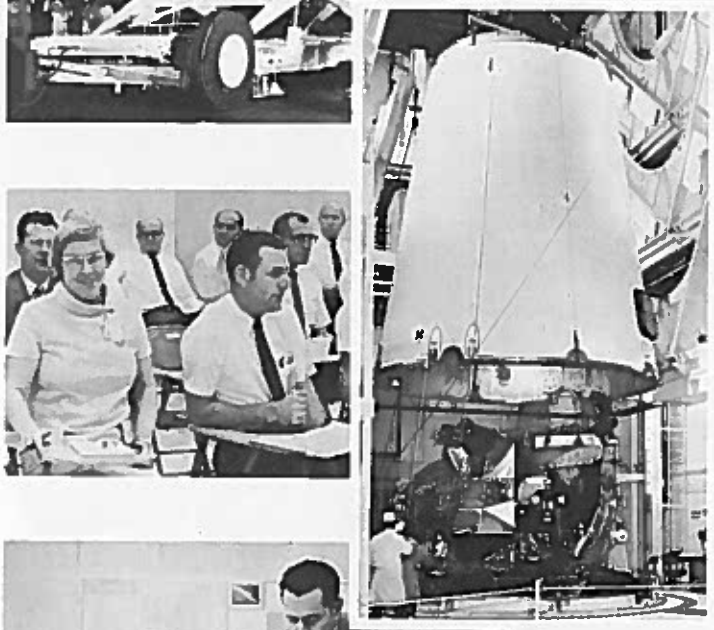
Add to these the individual experience and expertise acquired by thousands and thousands of Grummanites who are now contributing these enriched capabilities to other corporate endeavors and the benefits derived from Apollo could certainly be termed substantial.

As for Apollo—it has already made its impact on industry; no one can deny that. What imprint will it leave on our culture, our civilization? That can not truly be measured in our lifetime. The Renaissance and The Reformation both inspired new plateaus of imagination and thinking, but should their true impact be measured in years . . . or in centuries? So might it be with Apollo.

On July 20, 1969, the United States landed the first men on the moon and returned them safely to earth four days later. This nation had called many of its most talented people to fulfill that national commitment . . . and they responded to that call with unflagging dedication, tireless effort, and unceasing determination until that goal was achieved.

We salute those dedicated men and women . . . wherever they are.



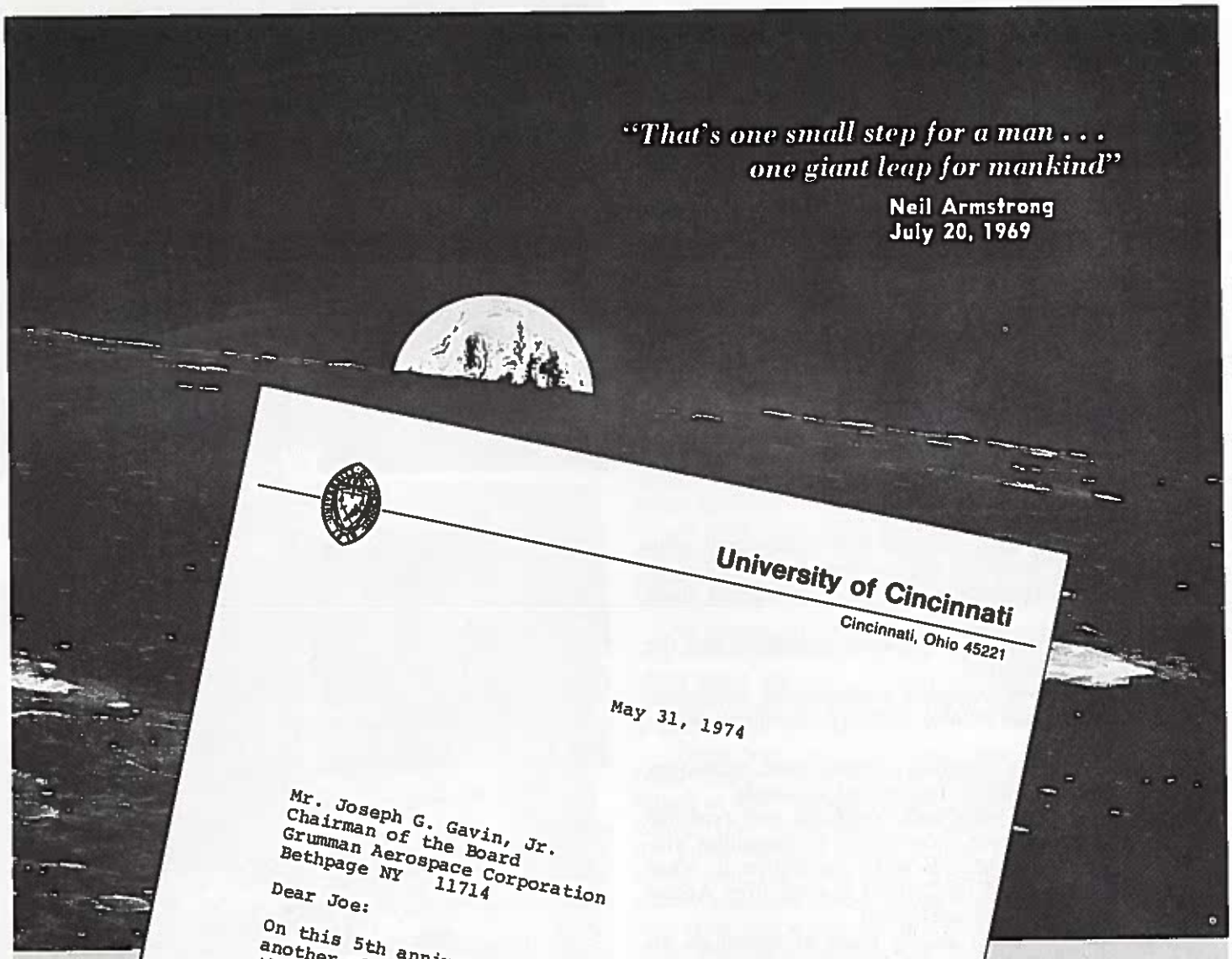


GRUMMAN
July 20, 1974 plane news

Special Commemorative Issue

"That's one small step for a man . . .
one giant leap for mankind"

Neil Armstrong
July 20, 1969



University of Cincinnati
Cincinnati, Ohio 45221

May 31, 1974

Mr. Joseph G. Gavin, Jr.
Chairman of the Board
Grumman Aerospace Corporation
Bethpage NY 11714

Dear Joe:

On this 5th anniversary of man's first landing on another planet, I would like to again congratulate the people of Grumman who were responsible for the design, construction, and test of the Lunar Module.

LM-5, the "Eagle", was a fine flying machine, living up to the expectations based on the many other fine Grumman aircraft I've had the pleasure of piloting.

The Lunar Modules assigned to the remaining Lunar Landing Flights have performed equally well. Their record of successes does great credit to all who participated in creating them and preparing them to fly.

The time of Apollo was a very special time. We're very fortunate to have lived in this small slice of history and even more fortunate to have played a part in it.

Best wishes for continued success to each and every one.

Sincerely,

Neil A. Armstrong